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**Applying complexity theory to understand Chinese consumers' decision making in
innovative products**

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Abstract: Innovation is more than new product development; it shifts consumers' behaviors surrounding the new products. This behavior is widely observed in the context of Chinese consumers' innovative product adoption behavior. Due to the speedy innovation product development and the resulting complex consumer behaviors, this study applies complexity theory to identify antecedent paths involving perceived risks (functional risk and emotional risk), innate consumer innovativeness, and consumers' demographics with information search (ongoing search and pre-purchase search) in the innovative products context. This study contributes a new perspective to Chinese innovation literature, using a configurational analysis, namely, fuzzy-set qualitative comparative analysis (fsQCA), which is based on an asymmetrical mode of thinking about the relationships among variables. The findings demonstrate the tenets (equifinality, complexity and asymmetry) of configurational analysis and reveal configurations of antecedents that are sufficient for consistently predicting the conditions when perceived risk associates with information search in the innovative products context. This work is designed to be the first to apply configuration theory to identify antecedent paths involving perceived risks with information search in the innovative products context. Therefore, this research is intended to contribute to the literature on perceived risk, information search and innovation management, particularly in the context of Chinese innovation.

Keywords: Chinese innovation; complex theory; innate consumer innovativeness; perceived risk; information search

Innovation is an essential component of economic development and organizational transformation, garnering substantial focus among researchers and industries (Barczak 2012; Kotler and Keller 2012), particularly when we examine the innovation in China, which is considered a potential global innovation leader (Roth, Seong, and Woetzel 2015; Woetzel et al. 2015). It has been acknowledged that innovation involves not only introducing the new products but producing a great shift in our behaviors surrounding the new products (e.g., Norden, Buston, and Wagner 2014; Zuckerman 2013), thereby driving a growing number of companies to produce innovative products based on customers' perceived values and deepening the customer-oriented management philosophy. Conversely, due to the complex nature of innovation products and consumer behaviors in this age, the manner in which consumers make decisions in adopting innovative products is complex and could constantly change. Specifically, the factor of uncertainty perception is what innovative products would bring to customers in their decision-making experience. How to control the perceived risk that is generated when customers purchase innovative products has become one of the essential topics in academia and industry. Since innovative products differ somewhat from established products in terms of function, appearance, and benefits, consumers typically engage far more in information search activities to understand how such products could be used and their potential benefits. This perceived risk is central to consumers' purchase decisions about innovative products. Therefore, research regarding the effect of perceived risk on information search is critically important to understanding purchasing behavior in the context of innovative products. Consumers usually utilize information search to reduce the perceived risk; therefore, researching on the interaction effect of perceived risk and

information search carries much weight for controlling perceived risk and understanding innovative products adoption behavior among Chinese consumers.

Information search is a process by which consumers make inquiries in the social environment and access appropriate data; therefore, they can make reasonable decisions (Solomon 2012). Information search is a persistent process behavior based on a collection of selection sets (Dellaert and Häubl 2012; Levav, Reinholtz, and Lin 2012; Pham and Chang 2010) and is driven not only by a consumer's desire to purchase a particular product but also by her own interests and habits before the purchase demand is generated (Bloch, Sherrell, and Ridgway 1986). Therefore, two distinct types of an information search occur: pre-purchase search and ongoing search (Bloch, Sherrell, and Ridgway 1986; Dholakia 1998).

Pre-purchase search refers to a consumer's search for specific information in response to purchase demands, while the ongoing search refers to a consumer's broader information-seeking behaviors targeted maintaining and upgrading personal knowledge. Most prior research on information search was conducted in the non-innovative product context, and thus focuses on pre-purchase search (Bloch, Sherrell, and Ridgway 1986). However, advances in information technology and the Internet enable companies to stimulate market interest before products are officially launched. The time interval between pre-release and official launch for new products continues to increase (Iyer and Davenport 2008). This new marketing strategy, which has become highly popular for innovative products, creates more opportunities for consumers to engage in ongoing search activities. Huawei, one of the leading Chinese innovative companies, is an example. The Huawei Watch was pre-released in Mobile World Congress on March 1, 2015 but was not listed for sale for nearly half a year

later, on September 2, 2015 (Huawei.com 2015). Therefore, the impact of ongoing search is considered a potentially crucial factor in the marketing of innovative products.

In addition, an individual trait called innate consumer innovativeness plays an important role in understanding the adoption of innovative products (Hirunyawipada and Paswan 2006; Lee, Lee, and Garrett 2013; Vandecasteele and Geuens 2010). Individuals have different preferences and tendencies to make innovative decisions or use innovative products (Hauser and Toubia 2005; Midgley and Dowling 1978). Innate consumer innovativeness refers to an inherent and unobservable characteristic that reflects an individual's tendency to innovate (Hirschman 1980; Hoffman et al. 2010). When applied in the specific domain of innovative products, innate consumer innovativeness represents a psychological trait that determines the degree to which a person will embrace newly released innovative products (Goldsmith and Hofacker 1991; Klink and Athaide 2010; Li, Zhang, and Wang 2015). Therefore, exploring whether or not the degree of innate consumer innovativeness influences the relationship between perceived risk and information search is worthwhile.

Empirical findings of the relationship between perceived risk and information search reveal inconsistencies. Some prior researches show that information search and perceived risk relate positively (e.g., Chaudhuri 1997; Murray 1991; Srinivasan and Ratchford 1991). Information search is an important factor that can affect perceived risks. Information search frequently reduces the risks that consumers encounter when evaluating products or services (Mitra, Reiss, and Capella 1999), and consumers readily employ information search as a strategy to address perceived risk (Bloch, Sherrell, and Ridgway 1986). Although scholars suggest that perceived risk has a positive effect on information search, Gemunden (1985)

finds that among more than 100 empirical studies, 51% of the research demonstrated no significant relationship or a negative correlation between perceived risk and information search. Conchar *et al.* (2004) suggest that information search can be a consequence of perceived risk rather than a proxy for perceived risk.

As Urry (2005) suggests that relationships between variables can be non-linear with abrupt switches occurring; therefore, the same “cause” can, in specific contexts, produce different effects. The current study advances an asymmetric stance to overcome the limitations of symmetric stance. Urry’s complexity turn indicates that whether the antecedent condition is positively or negatively related to an outcome condition depends on the particular complex configuration of other antecedents.

Therefore, the positioning of this paper is to investigate the relationship between perceived risks (functional risk and emotional risk) and information search (ongoing search and pre-purchase search) to understand the Chinese consumers’ innovative products adoption behavior. To address the complexity in this relationship, in contrast to the prior research, this study uses a method of configurational analysis, which is called fuzzy-set qualitative comparative analysis (fsQCA) that is based on an asymmetrical mode of considering relationships among variables. The purpose is to investigate how configurations of antecedent conditions involving perceived risks (functional risk and emotional risk) relate to information search (ongoing search and pre-purchase search) in the innovative products context, providing a new and useful approach to address this complex research question among Chinese innovation product consumers.

The remainder of this article is organized as follows. The next section provides a brief

review of the prior research related to perceived risk and information search. Section 3 introduces fsQCA as a configurational approach to present the antecedent recipes associated with perceived risk, consumer innovativeness and information search. The article then illustrates the empirical study method to test the theory. Section 5 analyzes the data and provides the findings. Finally, the last section presents a discussion of the results, contribution, limitations and future research.

PERCEIVED RISK AND INFORMATION SEARCH IN THE INNOVATIVE PRODUCTS CONTEXT

Many scholars have conducted researches on the dimensions of perceived risk (e.g., Kaplan, Szybillo, and Jacoby 1974; Roselius 1971), which suggest that perceived risk is a multidimensional concept. Roselius (1971) believes that consumers bear the risk of loss when making purchasing decisions; this includes time loss, hazard loss, ego loss and money loss. Kaplan, Szybillo, and Jacoby (1974) use regression analysis to determine the relationship between five components (physical risk, psychological risk, social risk, financial risk and performance risk) of risks and overall perceived risk across 12 products. The study finds that these five components can explain 74% of the variance of the overall risk. Thereafter, Murray and Schlacter (1990) conduct further research on the perceived risk. Financial risk is associated with money and risk capital; physical risk refers to physical, health, and energy aspects of loss; performance risk arises when products deliver functions and meet the needs of customers; social risk relates to the possible loss of respect and friendship with others when purchasing or using the products; psychosocial risks refers to the potential damage to

self-image in the process of the product purchase or product. Chaudhuri (2000) conduct principal component analysis on these five aspects of perceived risk and extracted two factors, namely, functional risk and emotional risk. Specifically, functional risk relates to financial risk, performance risk and physical risk, and emotional risk reflects the social and psychological risks. This study will adopt the concepts of the two dimensions of perceived risk, functional risk and emotional risk, to analyze the impact of the perceived risk on the information search of innovative products.

Information search not only includes pre-purchase information search that is related to specific product demands but also ongoing information search that is driven by consumers' personal interests and habits before purchase demand is generated (Bloch, Sherrell, and Ridgway 1986). However, in prior studies, most researchers consider only pre-purchase search. Consumers conduct pre-purchase information search to increase product knowledge, which enables them to make better purchasing decisions, which results in higher satisfaction with those decisions. Conversely, by continuously engaging in ongoing information search, consumers gain general product knowledge.

Innovative products differ from ordinary products in terms of functionality or appearance, which makes questions difficult for consumers to answer regarding whether or not they are useful and how to use them (Chakravarti and Xie 2006). Hence, innovative products are associated with higher perceived risk. When consumers believe the risk associated with purchasing innovative products is high, their purchase intentions decrease (Cox 1967; Stone and Grønhaug 1993).

Booz and Hamilton (1982) classify the innovative products and services into 6

categories based on two dimensions, newness to the company and newness to the market. The 6 categories are: new-to-the-world products, new product lines, additions to existing product lines, improvements to existing products, re-positioning and cost reductions. The innovative products and services proffered by Product Development and Management Association includes two types (PDMA, 2017). The first one is radical innovation, which refers to the really-new products that generally involve new technology and are able to significantly change consumer behavior and consumption paradigm in the market. Radical innovation corresponds to the first type of innovative product raised by Booz and Hamilton (1982), new-to-the-world products. The other is incremental innovation products, which improve the conveyance of a currently delivered benefit, but they do not produce the behavior or consumption change. Incremental innovation products cover the remaining 5 categories of innovative products and services by Booz and Hamilton (1982). This study adopts the definition and categorization by PDMA and focuses on the incremental innovation products to conduct further analysis.

Synthesizing the results of previous studies, here we divide perceived risk into functional risk and emotional risk (Chaudhuri 2000), and information search into pre-purchase search and ongoing search (Bloch et al. 1986). Next, we explore the various effects of different dimensions of perceived risk on information search behavior.

THEORETICAL CONFIGURATIONS OF THE EFFECT OF PERCEIVED RISK ON INFORMATION SEARCH

Configurational Model

In reality, most contexts very often include asymmetrical relationships and rarely include symmetrical ones (Ragin 2008). Greckhamer (2011) utilizes the configurational approach to investigate the combinations of cultural and macro-environmental attributes, which are associated with the differences existing in the compensation level and the compensation inequality. Hsiao *et al.* (2015) offer asymmetric empirical models via qualitative comparative analysis for all four sets of relationships of happy/unhappy and highly unproductive/productive employees. The researchers find that cases exist in nearly all large data sets that run counter to the main effects relationship. The limitations of using symmetric statistical tests to empirically examine theoretical relationships have led researchers to call for building and testing theory using algorithms from an asymmetric stance (Grandori and Furnari 2008).

Ragin (2006) proffers theory and provides fsQCA to build a model and test empirical relationships that consistently identify cases with high (or low) focal outcomes. The idea of fsQCA is to investigate how a conjunctive statement of antecedent conditions (“causal recipes”; Ragin 2008) rather than individual antecedents lead to a favorable (unfavorable) conclusion or decision (Feurer et al. 2014; Hsiao et al. 2015). Mathematically, fsQCA has no sample size limits (see also Fiss 2011; Ragin and Fiss 2008), which make fsQCA a powerful tool for a wide array of research problems in management. fsQCA bridges quantitative and qualitative methods in that “fuzzy sets have many of the virtues of conventional interval- and ratio-scale variables, but at the same time they permit qualitative assessment” (Ragin 2008).

Several tenets are probed in the study of antecedent conditions affecting an outcome by configurational analysis. The first tenet of configurational analysis is “equifinality”, that is, “a

few (not one) of the many possible paths lead to the same outcome” (Wu et al. 2014).

Equifinality assumes that two or more configurations can be equally effective in increasing searching behaviors within the same context (Hsiao et al. 2015). Thus, no one combination is necessary for accurately predicting customers' information search.

The second tenet of complexity is that relationships between variables can be non-linear with abrupt switches occurring; therefore, the same “cause” can, in specific circumstances, produce different effects (Urry 2005). The complexity tenet supports a shift from reductionist analyses to the study of complex vital matter that remains on “the edge of chaos” (Urry 2005). Hence, the configurational analysis focus transfers from examining the net effect or total effects to the study of alternative causal configurations, which consistently lead to a given outcome of interest (cf. Ragin 1997), such as customers’ perceived risk or information search.

The tenet of causal asymmetry is also stressed by configurational analysis. The causal asymmetry tenet indicates that the causes (recipes) leading to the rejection of an outcome are unique and not the mirror opposites of causes (recipes) of acceptance of the outcome (Ragin 2008; Woodside 2014). This tenet suggests that no one factor is sufficient or likely necessary for an outcome and research focusing only on the presence of an outcome of interest is unlikely to be very informative regarding the causes of the absence of the outcome (Ragin 2008; Woodside 2014). The tenet of causal asymmetry indicates that high perceived risk appears in algorithms associated with more information search; it does not mean that low perceived risk is an ingredient necessarily in all configurations that lead to less information search.

Furthermore, other tenets include that “unique complex antecedent configurations are

sufficient but not necessary for high scores in an outcome condition” and “simple antecedent conditions can be necessary. However, they are insufficient for indicating high scores in an outcome condition” (Wu et al. 2014).

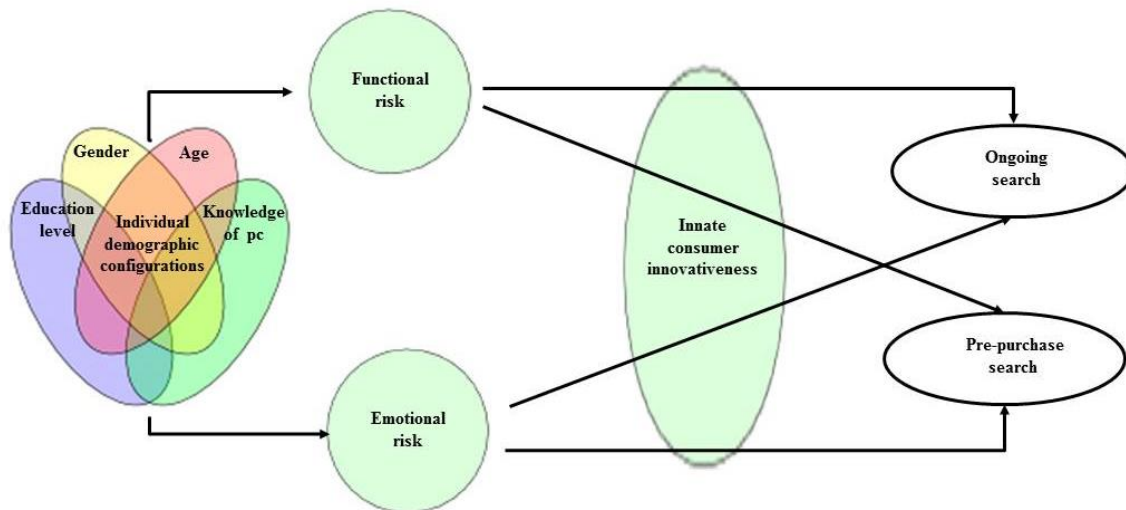


FIGURE 1 Configurational model

In this research, Venn diagrams (Duşa 2007) is used to model the causal configuration of complex antecedent conditions leading to perceived risk (functional risk and emotional risk) and information search (ongoing search and pre-purchase search) (See Figure 1). The arrows in Venn diagrams illustrate testable propositions of principal associations: (1) the influence of demographic configurations on configurations of perceived risk (functional risk and emotional risk); (2) the influence of configurations of perceived risk (functional risk and emotional risk) on ongoing search; (3) the influence of configurations of perceived risk (functional risk and emotional risk) on pre-purchase search; and (4) innate consumer innovativeness plays a moderating role for the effects of perceived risk on information search (ongoing search and pre-purchase search). The methodological approach elucidates the causal relationship between the characteristics of a configuration and an outcome of interest.

Relevancy of Demographics to Perceived Risk

The literature on the net effects of consumer demographic variables on perceived risk is numerous, which suggests that the levels of perceived risk will vary with the person (Hoover, Green, and Saegert 1978; Peter and Ryan 1976). Garbarino and Strahilevitz (2004) focus on how males and females differ in their perception of online shopping risks. Since perceived online purchase risk decreases as Internet usage increases (Kehoe, Pitkow, and Morton 1998; Miyazaki and Fernandez 2000), they control Internet usage and find that females will perceive greater online purchasing risk than males (Garbarino and Strahilevitz 2004). Phillips and Sternthal (1977) indicate that “age differences result in a complex set of changes in individuals' sources of information, ability to learn, and susceptibility to social influence”, which can lead to different levels of perceived risk. Mithcell (2001) also suggests that the elderly have more effective means to decrease risks.

In addition to gender and age, education can also affect perceived risk. Spence, Engel, and Blackwell (1970) find a slightly inverse relationship between the level of perceived risk and the years of education. This finding is true when a product was bought from a store. However, when the same product is purchased by mail, the researchers do not find the same relationship. In addition, evidence show that “lower education and larger family demographic clusters may purchase more extended warranties to reduce financial and performance risk” (Center for Policy Alternatives 1978).

Configurations of the Effect of Perceived Risk on Ongoing Search

Consumers adopt different decision modes based on context. A consumer's cognitive style and decision-making mode will change with the decision-making environment. Therefore,

different dimensions of perceived risk will have different effects on information search behaviors (Mitchell 1999).

Many scholars have suggested that information search and perceived risk are positively related (e.g., Chaudhuri 1997; Murray 1991; Srinivasan and Ratchford 1991); however, certain studies (e.g., Gemunden 1985) have found a negative relationship or no relationship between perceived risk and information search. Thus, a high level of perceived risk alone is neither sufficient nor necessary for a high level of information search.

Ongoing information search is not related to purchases. Instead, a consumer engages in ongoing search when she does not have specific purchase demands. The purpose of ongoing search is not to make better immediate purchasing decisions, but to make future purchasing decisions more enjoyable, to satisfy personal interests and to gain product knowledge. In other words, ongoing search is related to entertainment or recreation in the present, and generates product knowledge that can be used by the consumers or others in future decision-making situations.

Will customers make an increased or reduced information search when the functional risks of innovative products create excessive anxiety? Before consumers engage in ongoing information search related to recently launched innovative products, they know minimal functional information (e.g., price, application). By engaging in ongoing information search, consumers access not only detailed product information but also opinions about product features, price, and safety issues. Thus, accessing more information may actually have the effect of increasing consumers' perceived risk rather than reducing it. Mitchell (1999) believes that consumers deliberately avoid information that may cause cognitive dissonance,

and this avoidance behavior is more likely to occur in ongoing information search, which is not related to decision making. Because consumers engage in ongoing information search for pleasure or to satisfy personal curiosity, such information searching behavior is not obligatory. Since innovative products differ from other general merchandise in function or appearance, it may be difficult for consumers to discern how to use them and whether they are helpful.

However, emotional risk maybe has different effect on ongoing information search. When innovative products are pre-released, detailed information such as features and price are not disclosed to the public. Therefore, when searching for information, consumers tend to perceive the risks of innovative products from an emotional perspective (e.g., how others would evaluate them if they used the product and whether using the product would create other problems.). Emotional risk is the main problem that consumers want to mitigate when they engage in ongoing search; thus, emotional risk will affect ongoing search behavior.

Innate consumer innovativeness is an essential factor that affects consumer decision making regarding innovative products (Im, Bayus, and Mason 2003). As Cowart, Fox, and Wilson's (2008) study on consumer innovativeness and self-consistency shows, consumer innovativeness and perceived risk have a positive relationship with behavioral intention. For instance, highly innovative consumers have low levels of perceived risk and high levels of purchasing willingness. Bloch, Sherrell, and Ridgway (1986) report that individuals who engage more in ongoing information search are more likely to be opinion leaders; similarly, opinion leaders tend to be more innovative. According to Kirton's (1976) definition of innovativeness, highly innovative individuals prefer variation and are more inclined to accept new things. Conversely, innovative consumers prefer adventures and are more open to new

experiences; therefore, their self-concepts adjust more easily to change. Ongoing information search enables people to access more new information, which is consistent with innovative consumers' demands for novelty. Hence, the level of innovativeness may modify the relationship between perceived risk and ongoing information search.

Therefore, the configurational theory includes the proposition that perceived risk (functional risk and emotional risk) in recipes with innate consumer innovativeness and/or demographic antecedents are sufficient in predicting a high or low level of ongoing information search.

Configurations of the Effect of Perceived Risk on Pre-Purchase Search

Pre-purchase search is based on improving satisfaction with a specific purchase as well as obtaining information. That is, when consumers have previously considered purchasing a product, pre-purchase information search improves satisfaction by reducing perceived risk.

The accumulated information obtained through ongoing search can make future pre-purchase information search and purchase behavior more efficient (Bettman 1979).

Consumers frequently use information search to reduce perceived functional risks such as financial risk, performance risk and physical risk. In contrast to established products, the product knowledge accumulated through ongoing information search for innovative products is very limited. In addition, the prior research has shown that individuals who are knowledgeable or unknowledgeable engage less in information search than somewhat-knowledgeable individuals (Bettman and Park 1980). Therefore, in the context of pre-purchase information search, consumers who perceive a comparatively higher level of functional risk may not engage more in information search activities. In fact, it is possible

that such individuals may engage less in information search activities to avoid cognitive dissonance.

However, consumers reduce emotional risk by soliciting the opinions of others, which is generally unrelated to knowledge level. Consumers who engage in pre-purchase information search activities have previously decided to purchase (and therefore to accept social and psychological risks associated with) innovative products. Since social risk is external as opposed to internal, although a consumer is able to avoid information that conflicts with his self-concept, he cannot change others' evaluations of him once he uses the product. Therefore, a consumer may seek more information and opinions about an innovative product to minimize the conflict between the product and his self-concept.

Innate consumer innovativeness also modifies the effects of perceived risk on pre-purchase information search. Brucks (1985) suggested that consumers who make innovative decisions need relatively minimal information. Since highly innovative consumers are more likely to accept new things and are more receptive to innovative products, they require less information than others to make satisfactory decisions about innovative products. Therefore, consumer innovativeness influences the relationship of perceived risk and pre-purchase search. Similarly, the configurational theory includes the proposition that perceived risk (functional risk and emotional risk) in recipes with consumer innovativeness and/or demographic antecedents are sufficient in predicting pre-purchase search.

METHOD

Data Collection

A survey methodology was used to gather data for the research. Specifically, we explored how consumers' perceived functional risk and emotional risk affect their ongoing search and pre-purchase search behaviors, and we further analyzed the moderating effect of innate consumer innovativeness.

Data collection was accomplished through a two-stage process. First, we conducted a pilot test with 120 valid samples of university students. Based on the feedback, we revised and finalized the research stimulus and response scales. Second, we conducted the main study with participants using online panel data. Online questionnaires were randomly distributed. Random sampling method was used. The participants were first requested to read a paragraph with a detailed description of a recently launched version of tablet PC and answer a screening question indicating whether they believed the version of tablet PC was an innovative product. Then, respondents answered survey questions related to perceived risk, pre-purchase information search, ongoing information search, consumer innovativeness and demographic information.

In total, 360 participants took the survey, and there were 239 valid responses (including complete demographics), yielding a response rate of 66.4%. Responses from participants who did not pass the screening test (i.e., those who believed the tablet PC was not an innovative product) were eliminated from further analysis. The final data set included responses from 134 participants. The sample profile is shown in Table 1.

To examine whether the sample had a self-selection bias, we compared the demographic information of the two groups: the final data set with 134 valid responses, and the excluded data set with 105 responses. No significant differences were found. Finally, according to the

interviews with an online community manager, the highly educated participants in this study adequately represented early adopters of innovative products. Therefore, the sample we used in this research is representative for studying innovative products.

TABLE 1

Sample Profile

Demographic variables	Summary
Gender	Male: 61.9% Female: 38.1%
Age	Minimum=14 Maximum=74 Mean=28.6
Highest education level	1 (High school or below); 2 (Some college); 3 (Bachelor's Degree); 4 (Masters/some graduate school) Mean=2.67
Knowledge of Tablet PCs	1 (None); 2 (Too little); 3 (A little); 4 (Some); 5 (Quite a Bit); 6 (An Extreme Amount) Mean=4.04

Stimulus

A recently launched version of a tablet PC was selected as the research stimulus to represent an innovative product. A tablet PC is a personal computer that is small in size but full-featured. A tablet's appearance is similar to a laptop, but it is superior in terms of mobility and portability. The concept of a tablet PC was first proposed by Microsoft, and on January 28, 2010, Apple released its own version, the iPad. Currently, many consumers are choosing tablet PCs as second laptops. We used an innovative version of the tablet PC as our research stimulus for several reasons. First, an innovative version of tablet PC is a different and newer type of laptop, which is in accordance with our definition of an innovative product. Second, as a specific type of laptop, a tablet PC requires a high level of consumer involvement. Consumers engage more in information search when products are complex to

operate and require high levels of personal involvement. Third, both types of perceived risk are represented in the innovative version of tablet PC purchasing behavior.

Measures

We measured consumers' perceived risks associated with innovative products and the levels of ongoing and pre-purchase information search driven by the perceived risks. Furthermore, innate consumer innovativeness was also measured to assess its moderating effect. Based on knowledge obtained through in-depth interviews and our literature review, we modified existing scales to the innovative products context. We used 5-point Likert-type scales in this study, ranging from 1 (strongly disagree) to 5 (strongly agree).

Outcome Measures

We measured consumers' ongoing information search behavior. We adapted items used by Bloch, Sherrell, and Ridgway (1986) (e.g., "I often visit computer malls, just to look around or get information, rather than to make a specific purchase") to measure ongoing information search behavior. We combined the thirteen survey questions into a scale that showed very good reliability ($\alpha=0.89$). Based on the scale, we created a fuzzy set measures of membership in the set of consumers with high ongoing search, coding membership as fully out for a response of "strongly disagree" and fully in for a response of "strongly agree". The crossover point was the median of the scale ($=3.40$, i.e., approximately the 50th percentile).

In accordance with this approach, we measured consumers' pre-purchase information search behavior. We adapted items used by Claxton, Fry, and Portis (1974) (e.g., "Before purchasing, I will consider alternate brands") to measure pre-purchase information search behavior. The items were again combined into a scale that showed acceptable reliability with

a Cronbach's coefficient alpha of 0.76, which is above the preferable value of 0.70 (DeVellis 2003). Using this scale, we created a fuzzy set measures of membership in the set of consumers with high pre-purchase search, coding membership as fully out for a response of "strongly disagree" and fully in for a response of "strongly agree". The crossover point was the median of the scale (=3.92, i.e., approximately the 50th percentile).

Independent measures

Perceived risk. To measure perceived risk, we based our survey items on those used by Stone and Grønhaug (1993) (e.g., "If I bought this product, I feel that it would be a bad way to spend my money"). In accordance with the method used by Chaudhuri (2000), the study included using principal component analysis to analyze five dimensions of perceived risk. Two factors, functional risk and emotional risk, were extracted with a total explained variance of 70.5%. The rotated component matrix appears in Table 2. In subsequent analyses, we used the factor scores to represent functional risk and emotional risk. The items were combined into two scales that showed strong reliability (functional risk: $\alpha=0.85$; emotional risk: $\alpha=0.79$)

TABLE 2
Factor Analysis for Perceived Risk

		Factor 1	Factor 2
Functional risk	Financial risk	0.73	
	Performance risk	0.80	
	Physical risk	0.70	
Emotional risk	Social risk		0.73
	Psychological risk		0.67

Using these scales, we created two fuzzy set measures. Membership in the set of consumers with functional risk was coded as fully out for a minimum observed value of scale (=1) and fully in for a maximum observed value of scale (=4.73). For a crossover point, we chose the product of the 50th percentile values of scale (=2.73). Coding of membership in the set of consumers with emotional risk acted in accordance with the same approach.

Membership in the set of consumers with emotional risk was coded as fully out for a minimum value of scale (=1) and fully in for a maximum value of scale (=4.63). For a crossover point, we chose the product of the 50th percentile values of scale (=2.63).

Innate Consumer Innovativeness. We adapted the DSI (Domain-Specific Innovativeness) Scale developed by Goldsmith and Hofacker (1991) to measure consumer innovativeness (e.g., “In general, I am the first in my circle of friends to know the functions of the latest tablet PC”). Both items were combined into a scale that showed very good reliability ($\alpha=0.85$). The fuzzy set measure of innate consumer innovativeness was based on this scale and coded as fully out of the set for value 1 (“strongly disagree”). Because the maximum observed value was 5 (“strongly agree”), we coded this value as fully in the set of innate consumer innovativeness. We used the 50th percentile values of 3.14 as the crossover point.

Demographics. We measured demographics using four variables. The first variable was *gender*. Male was coded as full membership in the context of innovative digital product and female was coded as full non-membership. The second measure was *age*. Age ranging from 18 to 45 was coded as full membership; others were full non-membership. The third measure was *highest education level*. Answers to this question was measured on four levels (high school or below, some college, bachelor's degree, and masters/some graduate school). We

coded consumers with a degree at the high school or below level as fully out of the set of consumers with a high education level and consumers with a degree at the bachelor or above level as fully in the set, using the some college level as the crossover point. The last measure was *knowledge of tablet PCs*. The answer to this question was measured on a six-point scale. Using this scale, we created a fuzzy set measure. Membership in the set of consumers with knowledge of tablet PCs was coded as fully out for a value of 1 (“none”) and fully in for a value of 6 (“an extreme amount”); the scale midpoint of 3.5 was the crossover point.

Calibration

To use Boolean algebra to create complex configurations, we calibrated all variables into fuzzy-set scores range from 0 to 1, which specify the degree of membership for each case. Calibrated scores are membership scores resulting from calibrating original or interval scores and not probabilities. “In essence, a fuzzy membership score attaches a truth value, not a probability, to a statement” (Ragin 2008). Criteria for three breakpoints are necessary to perform fuzzy-set calibration: 0.05 for the threshold for full non-membership; 0.95 for the threshold of full membership; and 0.50 for the crossover point of the maximum ambiguity score between non-membership and membership (Ragin 2008). The fsQCA program (Ragin et al. 2006) provides a logarithmic function subroutine that calibrates original scores into logarithmic membership scores. When we specify the original values for these three breakpoints, the fsQCA program will calibrate other remaining scores. Thus, the fuzzy sets offer a middle path between quantitative and qualitative measurement but transcend many of the limitations of both. (Ragin 2008).

TABLE 3
Fuzzy Sets Calibration

Measures	Variable	95%	50%	5%
Outcome measures	Ongoing search	5	3.40	1
	Pre-purchase search	5	3.92	1
Independent measures	Functional risk	4.73	2.73	1
	Emotional risk	4.63	2.63	1
	Innate consumer innovativeness	5	3.14	1
	Highest education level	3	2	1
	Knowledge of tablet PCs	6	3.5	1
		1	0	
	Gender	Male	Female	
	Age	18~45	others	

Table 3 reported the calibrated value for antecedents and outcome conditions. The full membership, non-membership and crossover points for them were listed in the Table 3.

Gender is a dichotomous condition with 1 indicating male (full membership) and 0 indicating female (full non-membership). Age is calibrated as a crisp set, with 1 indicating ages ranging from 18 to 45 (full membership), and 0 indicating other ages (full non-membership).

ANALYSIS

Configurations for Ongoing Search

We use the notation for the presence of a condition. Circles with a cross-out (“⊗”) indicate its absence. Furthermore, large circles indicate core conditions, and small circles refer to peripheral conditions. Blank spaces in a solution indicate a “don’t care” situation in which the causal condition may be either present or absent. Solutions are grouped by their core conditions (Ragin and Fiss 2008).

Table 4 shows the results of our fuzzy set analysis of ongoing search. The solution table shows that the fuzzy set analysis results in one solution exhibiting acceptable consistency (≥ 0.80) (Fiss 2011) and furthermore indicates the presence of both core and peripheral

conditions.

TABLE 4
Configurations for Ongoing Search

	Solution		
	1a	1b	1c
Functional risk		⊗	⊗
Emotional risk		⊗	⊗
Innate consumer innovativeness	●	●	●
Highest education level	●		
Knowledge of Tablet PCs	●	●	●
Gender	●	●	●
Age	●	●	
Consistency	0.92	0.96	0.97
Raw coverage	0.43	0.39	0.38
Unique coverage	0.09	0.05	0.04
Overall solution consistency		0.92	
Overall solution coverage		0.53	

Regarding core conditions, solutions 1a, 1b and 1c indicate that innate consumer innovativeness and gender are sufficient for achieving a high level of ongoing search. Moreover, building on the necessary analysis condition test (Ragin 2000), a combination of innate consumer innovativeness and gender is a necessary condition.

TABLE 5
Necessary Analysis Condition Test

	Consistency	Coverage	Z-score
Innate consumer innovativeness + Gender	0.93	0.64	3.65***
Gender	0.72	0.62	-2.42
Innate consumer innovativeness	0.82	0.86	0.47

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, one-tailed tests; benchmark: 0.8

These solutions furthermore suggest that, with innate consumer innovativeness and gender, there are trade-offs among functional risk, emotional risk, highest education level, knowledge of tablet PCs and age. Specifically, solution 1b and 1c of Table 4 indicate that in the absence of high functional risk and emotional risk, two greater conditions among highest education level, knowledge of Tablet PCs and age allow for a high level of ongoing search regardless of whether another condition is high or not. In contrast, solution 1a shows the opposite pattern. In the presence of the highest education level, knowledge of tablet PCs and age, functional risk and emotional risk may be either high or low, as indicated by the blank space for functional risk and emotional risk that signal a “don’t care” situation for that causal condition. Comparing solutions 1a to 1b and 1c thus indicates that the risk and emotional risk and two high conditions among highest education level, knowledge of Tablet PCs and age can be treated as substitutes. Finally, the Table 4 shows the negative effect perceived risk on ongoing search and the positive effect on innate consumer Innovativeness and demographics on ongoing search.

The table also lists coverage scores that indicate the percentage of cases that take a given path to the outcome, allowing us to evaluate the importance of different causal paths (Fiss 2007). In terms of overall coverage, the combined models represent approximately 52 percent of membership in the outcome.

In accordance with an asymmetric understanding of causality in configurations, a fuzzy set analysis of the absence of a high level of ongoing search indicated no consistently identifiable solution, and consistency scores for all solutions remained considerably below the acceptable level of 0.75 (Fiss 2007, Fiss 2011). These findings indicate the absence of a

clear set-theoretic relationship when either the absence of a high level of ongoing search or the presence of a low level of ongoing search is used as the outcome.

Configurations for Pre-Purchase Search

Table 6 shows the results for a fuzzy set analysis of pre-purchase search. The results indicate the existence of four distinct configurational groupings, which again suggests the presence of across-type equifinality.

TABLE 6

Configurations for Pre-Purchase Search

	Solution			
	1	2	3	4
Functional risk	⊗	⊗	●	
Emotional risk		●	⊗	
Innate consumer innovativeness				●
Highest education level	●	●	●	●
Knowledge of Tablet PCs	●		⊗	●
Gender	⊗	⊗		⊗
Age	●	●	●	●
Consistency	0.94	0.95	0.97	0.93
Raw coverage	0.23	0.21	0.36	0.19
Unique coverage	0.02	0.01	0.11	0.01
Overall solution consistency				0.92
Overall solution coverage				0.55

Solution 1 indicates that the existence of a successful hybrid configuration that combines high education and knowledge of Tablet PCs with low functional risk for females as core conditions. Solution 2 indicates that, for female consumers, emotional risk produces a

positive effect on pre-purchase search, whereas functional risk produces a negative effect on pre-purchase search. Solution 3 indicates that, for people who know more about Tablet PCs, functional risk produces a negative effect on pre-purchase search, whereas emotional risk produces a positive effect on pre-purchase search. Finally, Solution 4 suggests that female consumers who have highly innate innovativeness are willing to do a pre-purchase search.

In terms of coverage, the solution represents approximately 55 percent of membership in the high level of pre-purchase search group, which is more than for the analysis of a high level of ongoing search.

Similar to configurations for ongoing search, in accordance with an asymmetric understanding of causality in configurations, a fuzzy set analysis of the absence of a high level of pre-purchase search indicated no consistently identifiable solution, and consistency scores for all solutions remained considerably below the acceptable level of 0.75. These findings indicate the absence of a clear set-theoretic relationship when either the absence of a high level of pre-purchase search or the presence of a low level of pre-purchase search is used as the outcome.

Robustness Checks

In accordance with Fiss (2011) and Garcia-Castro and Francoeur (2016), we conducted robustness checks to verify that the results shown hold under different calibrations. First, we varied the inconsistent consistency threshold to 0.9. No substantive changes are observed in terms of the relations depicted in Table 4-5. Furthermore, we increased the frequency cutoff to 3. Minor changes are observed as well as the specific number of solutions and sub-solutions, but the interpretation of the results remains substantively unchanged. Finally,

we varied the crossover points between +/-10 percent for all measures. Similar to the change in the frequency cutoff, minor changes are observed; however, the interpretation of the results remains substantively unchanged.

DISCUSSION

Findings

To understand the complex Chinese consumers' behaviors in adopting innovative products, we analyzed the effect of perceived risk, innate consumer innovativeness, and consumers' demographic background on information searching behaviors in a more detailed fashion by using configurational analysis.

In contrast to attempting to build and test models for both positive and negative outcomes of information search, configuration theory and fsQCA are asymmetric in focus (Ragin 2008; Fiss 2007; Fiss 2011). Therefore, what are included in the configurations leading to high level of information search by consumers in the innovative products context is a key finding of the current study.

First, Configurational analysis is a helpful lens because whether simple antecedent conditions relate to an outcome condition of interest positively or negatively, or not at all depends on the complex antecedent conditions. Thus, from the perspective of configurational analysis, presence/absence of perceived risk (functional risk or emotional risk) alone is not sufficient or necessary to predict and explain a high level of information search (ongoing search or pre-purchase search). Several ingredients acting in combination result in complex configurations that are sufficient in explaining and predicting high information search.

Furthermore, the result of our study is to find out the important role of innate consumer innovativeness to both ongoing search and pre-purchase search. Across all configurations for on-going search and one configuration for pre-purchase search, innate consumer innovativeness is shown to be the core condition. Although innovation research acknowledges the importance of innate consumer innovativeness, the prior research seldom simultaneously examines the effect of innate consumer innovativeness in both ongoing search and pre-purchase search. The current study provides empirical evidence to strongly support the central role of innate consumer innovativeness in shaping searching behavior.

Finally, the interesting finding of our study is that it clearly shows the role played by demographic information when consumers search innovative products. Configurations in Table 4 and 6 show the opposite results of how gender influences ongoing search and pre-purchase search. Furthermore, an accordance with Dwivedi, Joshi, and Misangyi (2017)'s method, we tested our idea in two different situations including gender (male/female subgroup) and age (18~45/others subgroup). Interestingly, we found that male consumers are strongly related with on-going search, whereas female consumers would attach great importance to the pre-purchase search. Furthermore, as the major consumer group for innovative products, individuals in the age group of 18 to 45 would contribute to both ongoing search and pre-purchase search.

Confirming the Tenets of Configurational Analysis

The tenets of configurational analysis receive supports from the findings. The multiple configurations leading to high level of information search (ongoing search and pre-purchase search) confirm the first tenet of equifinality. All configurations in the study include complex

antecedent conditions including several demographic characteristics indicate high value in the outcome condition for information search. For example, Table 6 indicates the existence of four distinct configurational groupings, which again suggests the presence of across-type equifinality. Solution 1a, 1b and 1c in Table 4 rely on the innate consumer innovativeness and gender. The solutions also show the clear trade-offs, with perceived risk and education level substituting for each other and allowing for neutral permutations around the core condition, indicating the presence of within-type equifinality.

The findings support the second tenet of complexity. For example, the configurations shown in Table 6 indicate that the simple antecedent conditions are not always positive or negative or always present in different complex antecedent conditions associating with the high level for pre-purchase search. For different segments, there are trade-offs between functional risk and emotional risk for effect on high level pre-purchase search. Thus, achieving high information search are complex undertakings, which are insufficient to describe or understand by examining the net effect or total effects.

The findings confirm the tenet of causal asymmetry. The configurations associating high level of information search (ongoing search and pre-purchase search) are not the mirror opposites of the configurations associating with the absence of high level of information search or the presence of low level of information search. The fuzzy set analysis of the absence of high level of information search indicated no consistently identifiable solution.

Contributions for Theory

This study contributes to theory by suggesting that the impact of perceived risks (functional risk and emotional risk) on information search (ongoing search and pre-purchase search)

depends on configurations of consumer demographics and consumer innovativeness in the innovative products context among Chinese consumers. The prior researches focus on whether or not perceived risks affect information search and whether or not the influence is always positive. Instead of studying narrowly on perceived risks and information search, a new configurational perspective is essential to learn the combinations of complex conditions whereby perceived risk depending on configurations of consumer demographics and innate consumer innovativeness associates with high level of information search.

Managerial Implications

Since perceived risk is an important factor influencing consumer purchasing decisions, particularly in this ever-changing innovative products context, studying how perceived risk affects consumers' information search behaviors among Chinese consumers has strong practical significance for Chinese innovation development.

The major implication originates from our findings with respect to how perceived risks, consumer innovativeness, demographic characteristics and information searching behaviors of innovative products operate together. Based on what we found in the study, companies should provide targeted information to consumers, considering demographics and innate consumer innovativeness. For example, our findings show that the male consumer is an important antecedent for ongoing search but not for pre-purchase search, whereas the female consumer is the opposite. The consumers in the age group of 18 to 45 are the major contributors to innovative product searching. According to the innovative product diffusion curve, the innovativeness levels of early adopters and subsequent users are not the same. Therefore, companies should focus on tailoring the information provided in marketing

campaigns at various diffusion stages for innovative products.

Currently, Internet service providers seek to focus on all the complex antecedent conditions associated with the information search level by consumers. These configurations are likely to include recipes with a different level of perceived risk (functional risk and emotional risk)/ innate consumer innovativeness/ demographics. It is possible and worthwhile to identify these alternative complex conditions for theory and practice.

Limitations and Future Research

In this study, we used the self-report method, which may not reflect actual marketing situations. In the future, researchers could conduct similar studies using observational methods or process tracking tests to overcome this limitation. In addition, for various types of innovative products, consumers' perceived risks will differ as will, the effect of perceived risks on information search. In this study, we adopted the DSI scale to examine innate consumer innovativeness based on a specific product; however, consumer innovativeness and its moderating effect may vary with the type of product. Finally, we use a tablet PC as the research stimulus. We encourage researchers to use other types of products as stimuli in future studies.

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